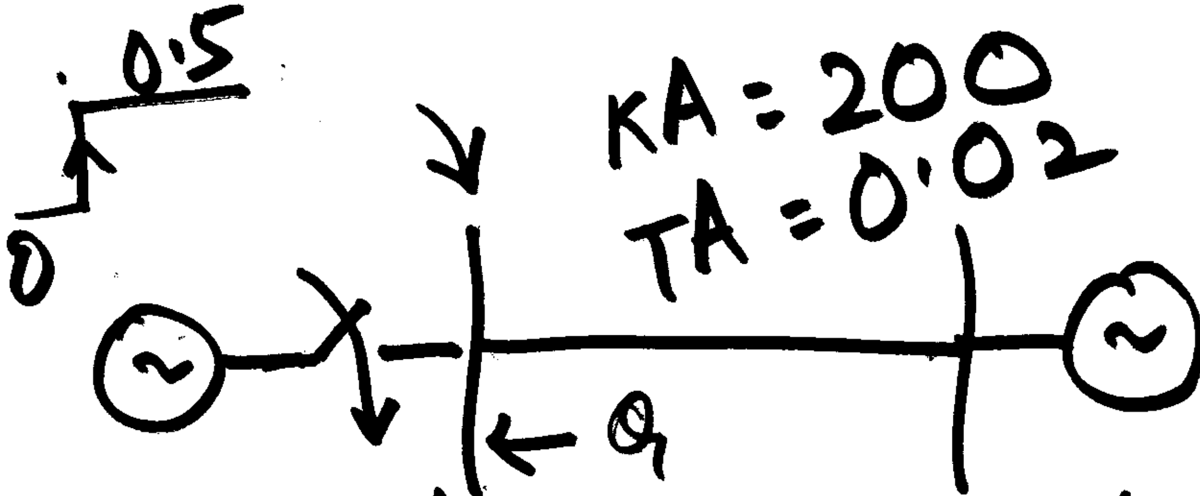
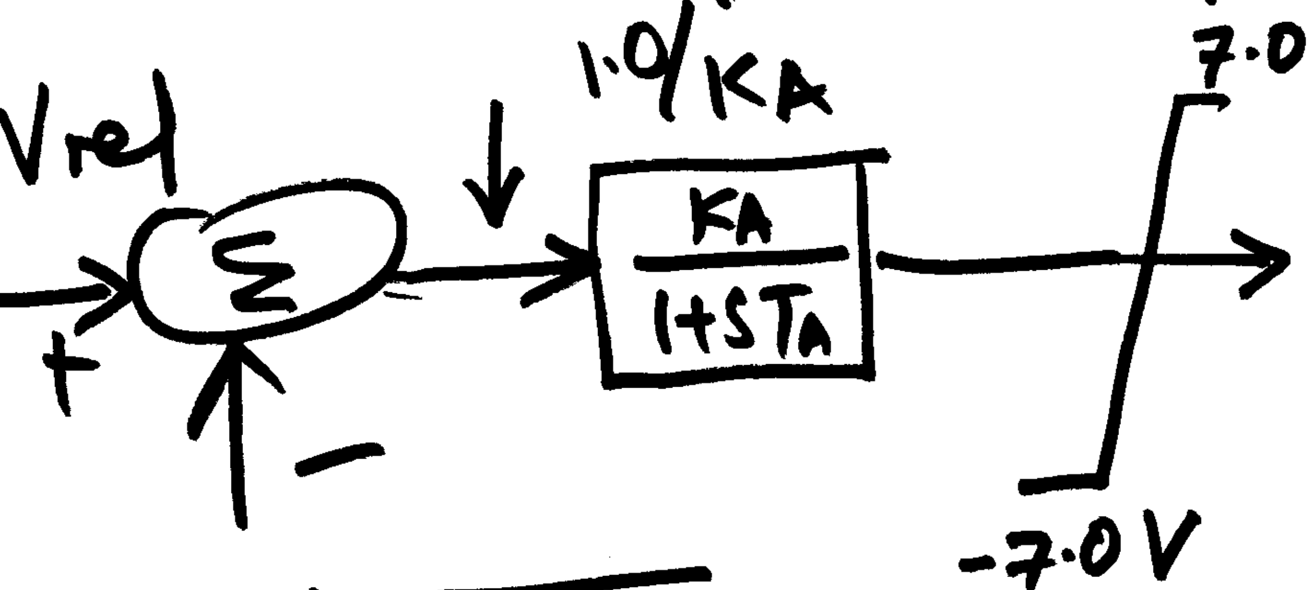
Prof. D.M. Kulkarni
Lec-29
Date 12/7/10

$K_A = 200$

$T_A = 0.02$





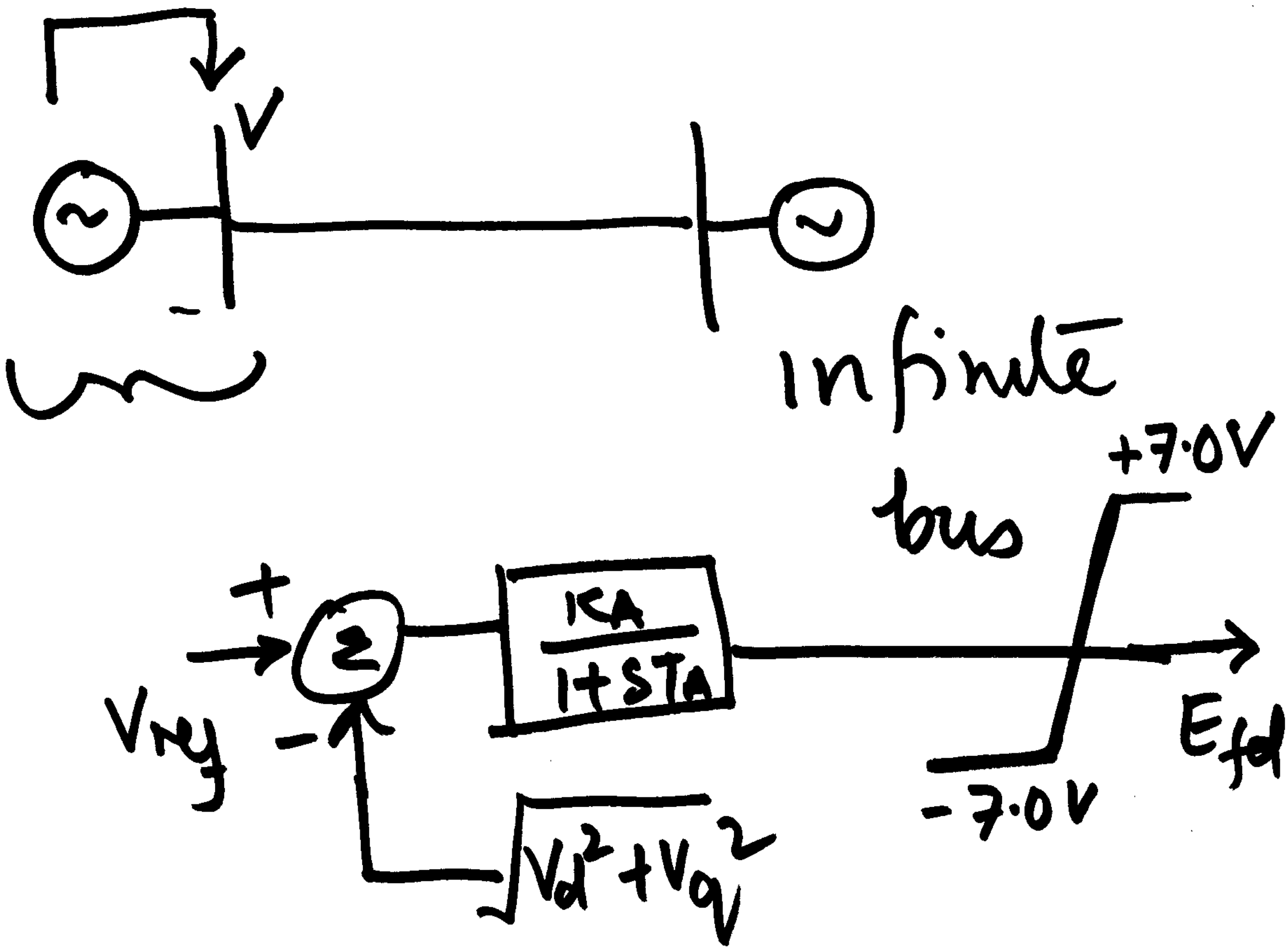
$E_{fd} = 1.0$

$V = \sqrt{v_d^2 + v_q^2} = 1.0$

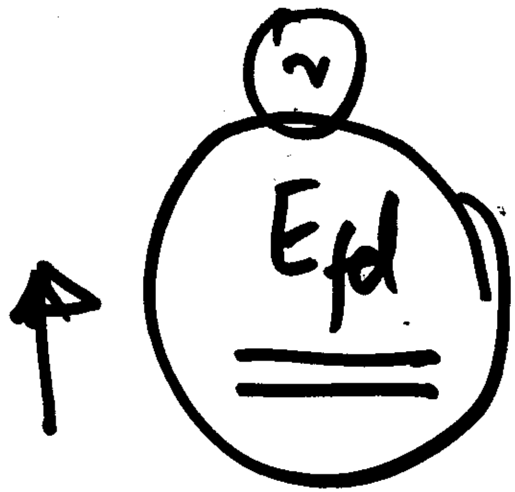
$V_{ref} = V + \frac{E_{fd}}{K_A}$

$= 1.0 + \frac{1}{200}$

$V_{ref} = 1.0 + \frac{1}{200} = 1.005$

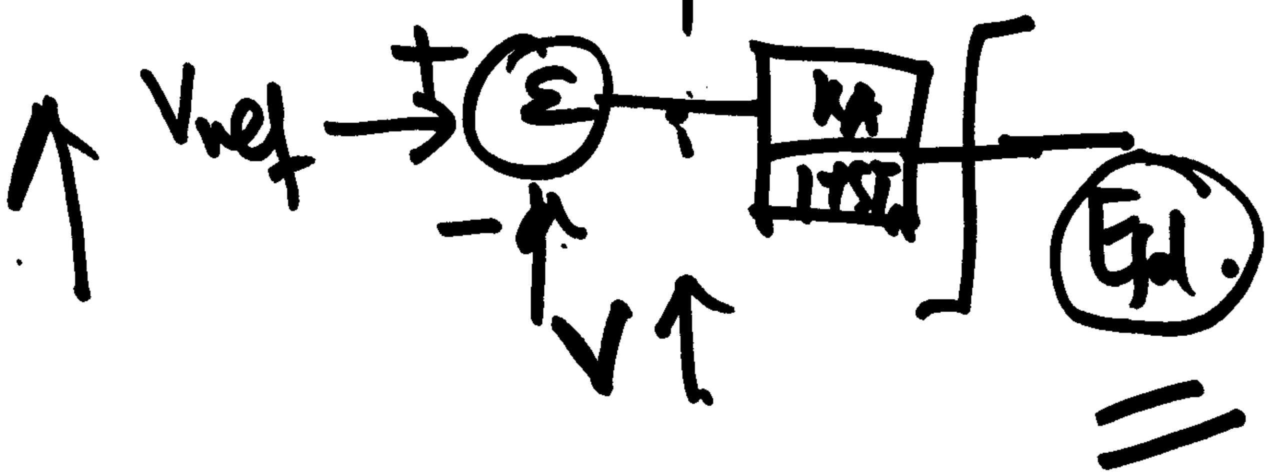


V
infinite bus
+7.0V
KA
1+STA
Vref
Efd
-7.0V
√(Vd²+Vq²)



1·0 terminals

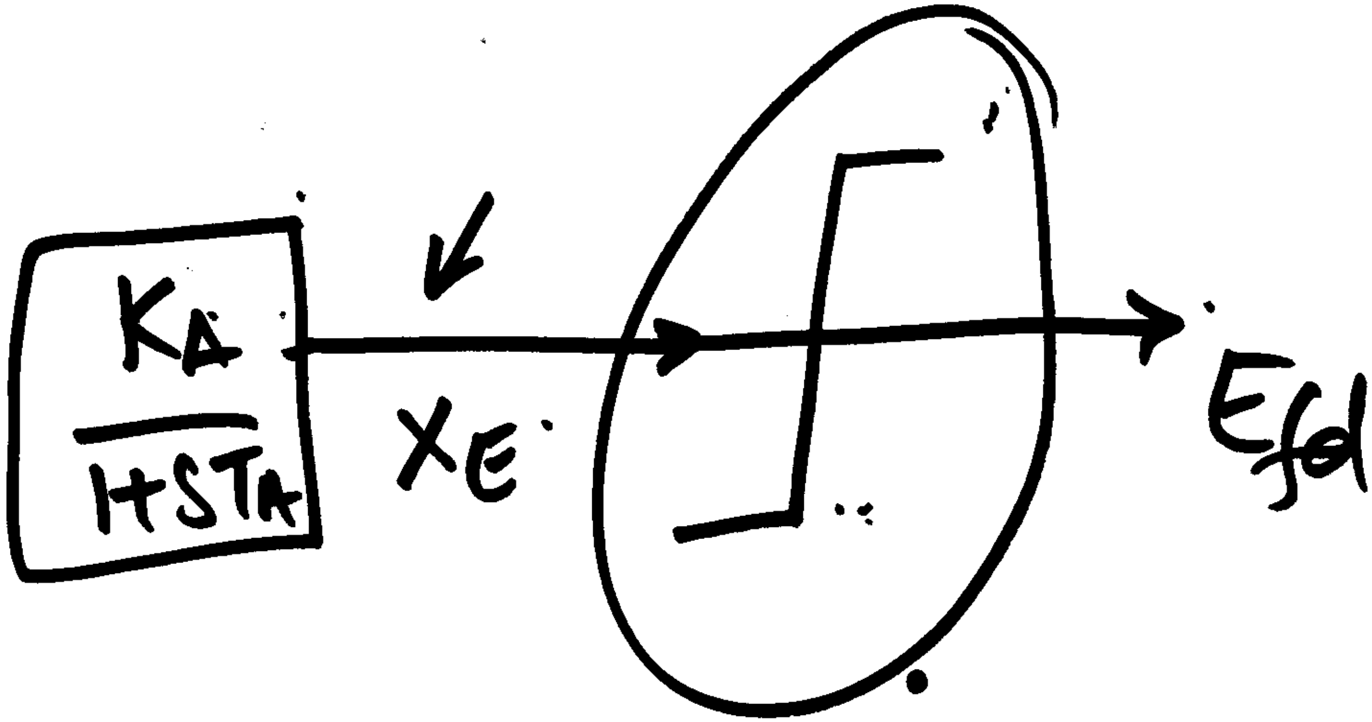
$T_m \uparrow$ $P_e \uparrow$



$\uparrow i$

$\downarrow V$

$E_{fd} \uparrow$



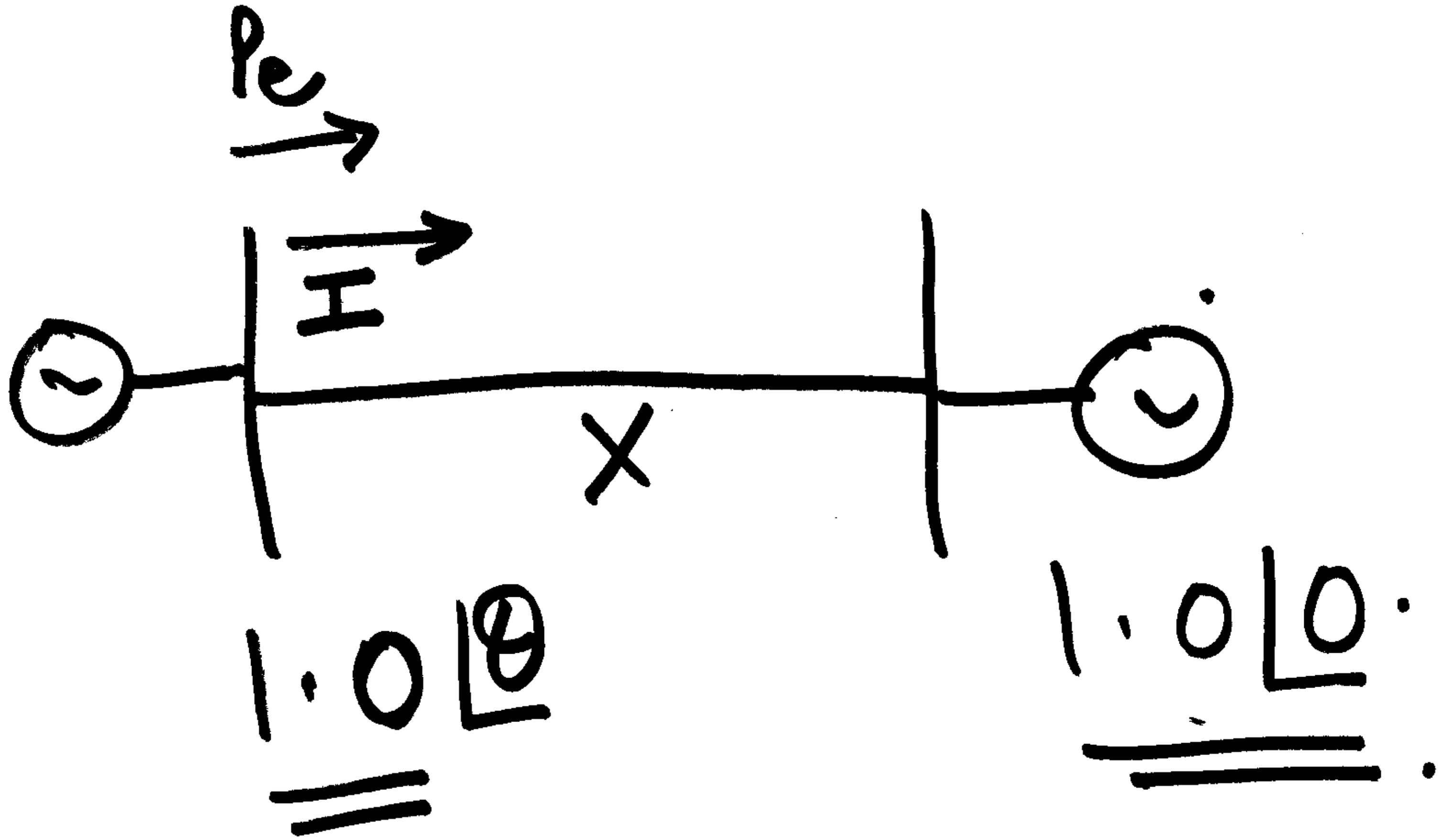
KA
1+STA
XE
Efd

$$\dot{x} = f(x)$$

$$\Delta\dot{x} = \left.\frac{\partial f}{\partial x}\right|_{x=x_e} \Delta x$$

① Linearize ←

② Equilibrium ←



$T_m = 1.0 = P_e$

δ , $\underline{\underline{\omega}}$, ψ

$$\boxed{\omega = \omega_0}$$

$$\boxed{\psi_d = x_d i_d + E_{fd}.}$$

$\left.\begin{matrix}\psi_F \\ \psi_H\end{matrix}\right\}\psi_d.$ $\dfrac{d\psi_F}{dt} = 0$ $\dfrac{d\psi_H}{dt} = 0$

$$\begin{bmatrix} 0 & -X \\ X & 0 \end{bmatrix} \begin{bmatrix} i_d \\ i_q \end{bmatrix} = -\left(\begin{bmatrix} V_d \\ V_q \end{bmatrix} - \begin{bmatrix} E_d \\ E_q \end{bmatrix} \right)$$

$$(i_q + j i_d) = \frac{(V_q + j V_d) - (E_q + j E_d)}{jX}$$

$$\left[E_{fd} + (x_d - x_q)\, i_d\right]$$

δ ✓

$$(v_q + j v_d)\, e^{j\delta} \rightarrow 1.0\angle\theta$$

$$(E_q + j E_d)\, e^{j\delta} \rightarrow 1.0\angle 0$$

$$(i_q + j i_d)\, e^{j\delta} =$$

$$\frac{\left[E_{fd} + (x_d - x_q)\, i_d\right] e^{j\delta}}{= (v_q + j v_d) e^{j\delta} + j x_q (i_q + j i_d) \cdot e^{j\delta}}$$

θ

v_q

v_d

$$(i_q + j i_d) e^{j\delta}$$

$$= \frac{1.0\angle\theta - 1\angle 0}{jX}$$

$$(i_q, i_d)$$ ✓

$$V = 1.0 \angle \theta$$

$$V_d = 1.0 \sin(\theta - \delta)$$

$$V_q = 1.0 \cos(\theta - \delta).$$

$$i_q + j i_d \quad (V_q + j V_d) e^{j\delta}$$

$$\rightarrow 1.0 \cos\theta + j\, 1.0 \sin\theta$$

$$\begin{cases} v_{an} = \sqrt{\frac{2}{3}} \sin(\omega_0 t + \theta) \\ v_{bn} = \sqrt{\frac{2}{3}} \sin\left(\omega_0 t + \theta - \frac{2\pi}{3}\right) \\ v_{cn} = \sqrt{\frac{2}{3}} \sin\left(\omega_0 t + \theta - \frac{2\pi}{3}\right) \end{cases}$$

θ

v_d , v_q .

$1.0\angle 0 \rightarrow E_{an}$

E_{bn}

E_{cn}

$$E_d = -E\sin\delta$$
$$E_q = +E\cos\delta$$

E_{an}

$$= \sqrt{\tfrac{2}{3}} \sin(\omega_0 t)$$

$1.0\angle\theta$

$$(E_q + jE_d)e^{j\delta}$$
$$= 1.0 + j0.0.$$

$$\underline{(v_q + j v_d)} = E_{fd} - j x_d (i_q + j i_d)$$

$$- j x_q i_q$$

$$+ j x_d i_q .$$

$$= E_{fd} - j x_q (i_q + j i_d)$$

$$+ (x_d - x_q) i_d$$

$$v_d = -x_q i_q$$

$$v_q = x_d i_d + E_{fd}.$$

$$(v_q + j v_d) = E_{fd} + j x_d (i_q + j i_d)$$

$$-j x_q i_q$$

$$+j x_d i_q$$

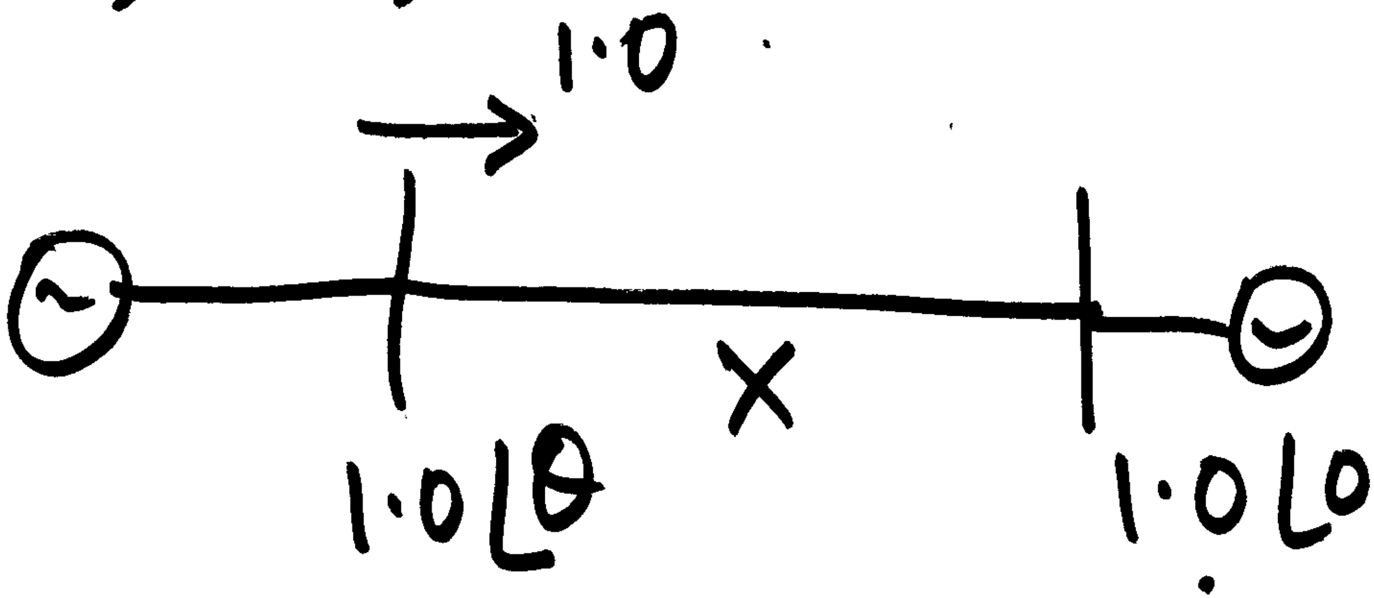
$$(V_q + jV_d) = E_{fd} - jx_q(i_q + ji_d)$$

$$+ (x_d - x_q)i_d.$$

$$\therefore \; E_{fd} + (x_d - x_q)i_d$$

$$= \underline{(V_q + jV_d)} + jx_q\underline{(i_d + ji_d)}$$

E_{fd} , δ ,



$$\psi_q = x_q i_q \quad \Big\} \; s.s.$$

$$0 = -\omega_0 \psi_q - \omega_B R_a i_d - \omega_B v_d$$

$$0 = +\omega_0 \psi_d + \omega_B R_a i_d - \omega_B v_q$$

$$\underline{v_d = -\psi_q \quad v_q = \psi_d .}$$

$$P_e = 1.0 = \frac{1.0 \times 1.0 \times \sin\theta}{X}$$

$$\theta = \sin^{-1}\left(\frac{1.0 \times X}{1.0 \times 1.0}\right)$$

$$I = \frac{V\angle\theta - E\angle 0}{jX}$$